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(54) Title of Invention:	A Device for Identifying and Counting Paper Currency
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(57) Claim:

1   A device for identifying and counting paper currency, wherein the notes of paper currency stored in a first paper currency housing unit are extracted sequentially one at a time and conveyed to a second paper currency housing unit as the number of conveyed notes of paper currency is counted, and wherein said device for identifying and counting paper currency is equipped with (a) a detection unit to detect the denomination of the notes of paper currency, (b) an identifying unit to identify the denomination of the notes of paper currency based on the detection signals from said detection unit, (c) a counting circuit to count the conveyed notes of paper currency based on the identification signals outputted by said identifying unit, and (d) a display device to display the count details from said counting circuit, and wherein said device is able to count and display the monetary totals from mixed batches of notes of paper currency housed in said first paper currency housing unit.

The present invention pertains to a paper currency processing device that extracts notes of paper currency one by one and performs the desired processing such as counting the notes of paper currency. The present invention pertains more specifically to a device for identifying and counting paper currency that accurately identifies and counts notes of paper currency.

In these types of devices, the notes of paper currency are extracted one at a time from a stack of paper currency by an extraction mechanism and then conveyed. The denomination of the notes of paper currency is identified, and the total number of notes of paper currency and the total amount of money are counted. After the desired number of notes of paper currency has been extracted, the device shuts down. At the present time, the operator has to verify the denominations of the notes of paper currency (money) counted by the device. If the notes of paper currency with the wrong denomination are mixed in, the total number of notes of paper currency and the total amount of money displays are both incorrect. The purpose of the present invention is to provide a device for identifying and counting paper currency that automatically identifies the denominations of the notes of paper currency during the count by indicating the denomination

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of the notes of paper currency to be counted. If a note of paper currency with the wrong denomination is detected, the counting operation can be suspended or cancelled by the device.

The following is an explanation of the preferred embodiments of the present invention with reference to the drawings.

In Fig. 1, the loading unit 2 is situated in the top portion of the counting device 1, and conveyor belts 3, 3 are situated on both sides of the loading unit 2 to extract the notes of paper currency.

As shown in Fig. 2, the conveyor belts 3, 3 are wrapped around pulleys 4, 5. Ribs are formed in the outside surface of the belts 3, 3 to increase the force of friction with the notes of paper currency P. The drive is applied in the direction of the arrow from the motor M and belt 6 towards pulley 5. An eccentric pulley 7 is situated in the position corresponding to the inner edge of the loading unit 2. When the portion of the eccentric pulley 7 with the wider radius 7a comes into contact with the inner surface of the running belt, the outer surface of the running belt strikes the surface of the loading unit 2. When the portion of the eccentric pulley 7 with the narrower radius 7b comes into contact with the inner surface of the running belt, the outer surface of the running belt falls short of the surface of the loading unit 2. As a result, the up and down movement of the belt 3, 3 intermittently extracts the notes of paper currency P from the bottom of the loading unit 2 one by one.

The outer surface of a reverse roller 8 comes into contact with the middle portion of the upper surface of the belts 3, 3 and rotates in the opposite direction. It rotates around a shaft 11 supported by another shaft 9 on the tip of a fixed arm 10 at intervals large enough to allow a single note of paper currency to pass between it and the belts 3, 3. A guide pulley 41 to support the position of the belts 3, 3 is situated on the bottom surface of the belts 3, 3 in the position corresponding to the reverse roller 8.

The upper portion of a pressure member 14, supported by a portion 12 of the main body 1 of the counting device and a shaft 13, is situated on the paper currency input side of the reverse roller 8 so as to be able to

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oscillate. The lower portion 14a comes into contact with rods 15, 15 in order to avoid contact with the outer surface of the reverse roller 8 and the belts 3, 3. It is bent at the proper angle towards the reverse roller 8 so as to straddle the reverse roller 8 and belts 3, 3 in the interval between the rods 15, 15. The lower portion 14a is inclined away from the reverse roller 8 by a spring 16.

A large diameter roller 18 is attached to the pulley shaft 17 on the drive side of the conveyor belts 3, 3 and a semicircular guide plate 19 is added to the outside half of this roller 18 to provide a small space between it and the outer surface of the roller 18. The bottom edge of the guide plate 19 is connected to a chute 20 used to guide the front edge of the notes of paper currency P, and the bottom edge of the chute 20 comes up to the upper surface of a conveyor belt 21 that is disposed horizontally. It comes up against the upper surface of this conveyor belt 21 [sic]. The other end of the conveyor belt 21 comes up to the discharge slot 22 in the main body 1 of the counting device and is configured so that the notes of paper currency P discharged from the discharge slot 22 into a paper currency collection unit 23 situated at the discharge slot 22. The base of spring-loaded pressure plates 24 fixed to the main body 1 of the counting device are attached above the paper currency collection unit 23 so that the notes of paper currency P do not fly off when discharged into the paper currency collection unit 23.

A booster plate 25 extends from near the bottom of the loading unit 2 on the front end to near the backside pulley 5 on the back end between the conveyor belts 3, 3. It is supported so as to oscillate freely on a shaft 26 that is situated slightly beyond the center of the reverse roller 8. The surface of the booster plate 25 is positioned slightly higher than the upper surface of the conveyor belts 3, 3 raised by the eccentric pulley 7 when the front end 25a is raised, and is positioned slightly lower than the upper surface of the conveyor belts 3, 3 when the front end 25a drops below the shaft 26.

The shaft 26 is attached to an arm 27 with a link 30 connecting the tip of arm 27 to the tip of arm 29 attached to shaft 28. A lever 32 is attached to this shaft 28 so as to change between two positions. In one of these positions, the grooves 31 on the bottom surface of the pressure member 14 are engaged and the bottom tip 14a of the pressure member 14 extends down the front side of the reverse roller 8. (This

10,000-yen denominations. The total number of notes by denomination is stored in the memory. When mixed denomination totals are calculated, the denomination selection keys 103 and the operation mode selection buttons 106 are used. The function keys are used to display these mixed totals on the display unit 101 by way of the addition control unit 204. Like the first memory 202, the main memory 203 has memory units for the four denominations 500 yen, 1000 yen, 5000 yen, 10,000 yen to store the totals. The denomination selection keys 103 and the total key 107 (i.e. function keys) are used to display the stored data on the display unit 101. In the case of common paper calculations and single denomination calculations, the addition control unit 204 stores the calculations by denomination in the first memory 202 via the add gate 201, converts this data to the various totals, and sends this with the denomination number of notes data to the display unit 101 for display. In the case of multiple denomination calculations, the denomination calculation data stored in the first memory 202 is converted to total amount data using the denomination selection keys 103 and the subtotal key 108, and then sent with the denomination number of notes data to the display unit 101 for display. When the subtotal key 108 is used, the addition control unit 204 adds the data in the first memory 202 to the denomination units in the main memory 203. The denomination data stored in the main memory 203 is converted to total data by using the denomination selection keys 103 and the total key 107. In the case of batch mode, the denomination data in the first memory 202 is batched based on input from the note number setting unit 104, and a match signal CN is outputted when the calculation matches the input.

When the total key 107 is used to indicate a data display for the main memory 203, a main memory display command is applied to the addition control unit 204 by operating the denomination selection keys 103 beforehand. When the subtotal key 108 is used to indicate a data display for the first memory 202 or a display adding the data in the first memory 202 to the main memory 203, an addition command is applied to the addition control unit 204 by operating the denomination selection keys 103 beforehand. The display 101 is divided into a number of notes display 101A and a total amount of money display 101B. In the case of single denominations (or common paper), the denomination total is displayed along with the total number of notes. In the case of mixed denominations (in which the totals are retrieved), the denomination data is displayed based on specific operations. Because the mode selection unit 127 inputs signals from the

denomination count selection button 105 and the operation mode selection button 106 and outputs mode signals MS to perform calculations, when the batch mode is selected and when common paper is selected in the calculation or addition mode, the identifier 112, denomination selection keys 103 and denomination storage unit 113 are deactivated, and the paper currency detection signals outputted from the conveyed paper currency detection unit 126 are used to calculate the number of notes in the 10,000 yen denomination register 202A.

The operation mode selection buttons 106 are used to select one of three calculation modes: (1) count mode for counting the total number of notes for a common paper calculation and the total number of notes and total amount of money for single and multiple denomination calculations in which the count proceeds until there are no more notes left in the loading unit 2 at which time the conveyor drive unit 120 is shut down automatically by a count termination signal CF from the count completion detection unit 128; (2) an addition mode in which the notes of paper currency in the loading unit 2 are counted one by one with the data displayed in the denomination registers 202A-202D during the count and the data totaled in the denomination registers 202A-202D and the total number of notes for a common paper calculation and the total number of notes and total amount of money for single and multiple denomination calculations displayed when the count termination signal CF is outputted; and (3) batch mode in which a match signal CN is inputted to the count completion detection unit 128 when the notes of paper currency in the paper currency collection unit 23 detected by the paper currency capacity detection unit 129 match the number of notes set using the note number setting unit 104, the paper currency in the paper currency collection unit 23 is extracted, the conveyor drive unit 120 resumes operation with the set number of notes calculated and displayed, and in which the conveyor drive unit 120 stops when the set number of notes has not been reached and a no-denomination detection signal NE is outputted and the conveyor drive unit 120 does not resume operation until additional notes have been placed in the loading unit 2.

The following is an explanation of the operation of this device when notes of a single denomination of paper currency are counted in addition mode.

First, "single denomination" is selected using the denomination count selection buttons 105 and "addition mode" is selected using the operation mode selection buttons 106. When the denomination of paper currency to be counted has been selected using the denomination selection key 103, a selected denomination signal is outputted from the particular denomination selection key 103. In this case, the "10,000" yen denomination has been selected.

When the bundles of paper currency to be counted are placed in the loading unit 2, the paper currency is detected by the paper currency capacity detection unit 122 and a detection signal is inputted to the conveyor control unit 121 as a start command.

The conveyor control unit 121 outputs control signals to operate the conveyor drive unit 120, and the notes of paper currency in the loading unit 2 are then one by one extracted and conveyed by the conveyor belt 3.

Because the pattern detection unit 111 is situated between the loading unit 2 and the conveyed paper currency detection unit 126, the pattern of the conveyed paper currency is detected by the pattern detection unit 111, and pattern detection signals are outputted. Based on this input, the identifier 112 outputs identification signals indicating the 10,000-yen denomination. The denomination collation unit 114 inputs and collates these identification signals with the denomination signals from the denomination selection key 103, and outputs a "match" or "mismatch" collation signal RF. If the collation signal is a "mismatch" signal, the conveyor control unit 121 stops the conveyor drive unit 120. The wrong denomination paper currency discharge unit 123 is operated before the conveyor drive unit 120 is shut down, and the note with the wrong denomination is discharged instead of being conveyed to the paper currency collection unit 23.

The conveyed paper currency is conveyed from the location where the pattern detection unit 111 is situated to the location where the conveyed paper currency detection unit 126 is situated. The conveyed paper currency detection unit 126 outputs a single-pulse conveyed paper currency detection signal TN as the note of paper currency passes. The conveyed paper currency detection signal TN is inputted to the add gate 201 in the counting unit 200. When a "match" collation signal RF has been inputted, the conveyed paper

currency detection signal TN is inputted to the "10,000" yen register 202A corresponding to the denomination signal outputted from the denomination storage unit 113. The signal is counted. The number of notes counted is then displayed on the number of notes display unit 101A in the display unit 101. The contents of the "10,000" yen register 202A changes the total in the addition control unit 204, and this is displayed in the total amount display unit 101B in the display unit 101. The notes of paper currency are extracted and conveyed one at a time, and are identified and counted one at a time. When there are not more notes of paper currency in the loading unit 2, notes of paper currency are no longer detected by the paper currency capacity detection unit 122 and no detection signals are outputted. Because notes of paper currency are no longer being detected by the conveyed paper currency detection unit 126, the timer circuit 125 outputs a no-currency signal after a specific amount of time has elapsed without receiving a conveyed paper currency detection signal TN. The count completion detection unit 128 outputs a count completion signal CF, the data in the first memory 202 is transferred to the main memory 203, and the conveyor drive unit 120 is shut down. If more notes of paper currency are placed in the loading unit 2, the same process is repeated.

The following is a description of the operation of the device when "multiple denominations" is selected using the denomination count selection button 105 and the "count mode" is selected using the operation mode selection button 106.

When a bundle of mixed denomination paper currency is placed in the loading unit 2, the conveyor drive unit 120 is activated, the notes of paper currency are extracted and conveyed one at a time, and the pattern detection unit 111 outputs a pattern detection signal to identify the denomination of the conveyed paper currency. The identifier 112 outputs the identification signal indicating the denomination, and the denomination collation unit 114 inputs the mode signal MS from the mode selection unit 127 and does not operate. The add gate 101 inputs the conveyed paper currency detection signal TN from the conveyed paper currency detection unit 126 corresponding to the denomination signal to the register 202A-202D in the first memory 202 corresponding to the denomination. The number of notes for each denomination and the total amount of money are shown in the number of notes display unit 101A and the total amount display

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unit 101B in the display unit 101. Display units 101 with a single display mean can be designed to display the number of notes per denomination in successive order using separate denomination display keys. The display unit can also be equipped with display means corresponding to each denomination register.

The display for the total amount of money is similar.

When the "addition mode" is selected and there is no longer any mixed denomination paper currency in the loading unit 2, a count termination signal CF is outputted from the count completion detection unit 128. The addition control unit 204 adds the contents of the denomination registers 202A-202D, and displays the contents of the total count circuit in the main memory 203 on the display unit 101 in number of notes and total amount of money. When another bundle of paper currency is placed in the loading unit 2, the conveyor drive unit 120 is automatically activated. The number of notes is tallied in the registers 202A-202D by means of the add gate 201 and then displayed on the display unit 101. When the tally is complete, the total number of notes per denomination and the total amount of money are displayed. When "mixed denomination" or "single denomination" is selected and the denomination to be counted is selected using the denomination selection keys 103, the identification signals from the identifier 112 are collated by the denomination collation unit 114. Notes of paper currency of other denominations are discharged from the discharge slot by the wrong denomination paper currency discharge unit 123. Only notes of paper currency with the selected denomination(s) are conveyed to the paper currency collection unit 23 and counted by denomination.

When "common paper" or "batch mode" is selected, denomination identification is not performed and the denomination selection keys 103 are locked.

In this preferred embodiment, the denomination selected using the denomination selection keys 103 is stored in the denomination storage unit 113, and the denomination collation unit 114 collated the stored denomination. However, the denomination identified initially by the identifier 112 can be stored in the denomination storage unit 113 and then inputted to the denomination collation unit 114.

Brief Explanation of the Drawings

Fig. 1 is a external perspective view of the device for identifying and counting paper currency in the present invention. Fig. 2 is a view of the internal mechanism. Fig. 3 is a block diagram of the control circuit. Fig. 4 is the configuration of the pattern detection unit.

101 ... display unit

102 ... clear key

103 ... denomination selection key

104 ... note number setting unit

105 ... denomination count selection button

106 ... operation mode selection button

107 ... total key

108 ... subtotal key

109 ... stop button

110 ... power supply switch

111 ... pattern detection unit

112 ... identifier

113 ... denomination storage unit

114 ... denomination collation unit

120 ... conveyor drive unit

121 ... conveyor control unit

122, 129 ... paper currency capacity detection unit

123 ... wrong denomination paper currency discharge unit

124 ... error detection unit

125 ... timer circuit

126 ... conveyed paper currency detection unit

127 ... mode selection unit

128 ... count completion detection unit

200 ... counting unit

201 ... add gate

202 ... first memory

203 ... main memory

204 ... addition control unit

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Fig. 1

Fig. 4

Fig. 2

Fig. 3

101A ... number of notes display unit

101B ... total amount display unit

105A ... common paper

105B ... single denominations

105C ... multiple denominations

106A ... calculation mode

106B ... addition mode

106C ... batch mode

107 ... total key

108 ... subtotal key

109 ... stop button

111 ... pattern detection unit

112 ... identifier

113 ... denomination storage unit

114 ... denomination collation unit

120 ... conveyor drive unit

121 ... conveyor control unit

122, 129 ... paper currency capacity detection unit

123 ... wrong denomination paper currency discharge unit

124 ... error detection unit

125 ... timer circuit

126 ... discharged paper currency detection unit

127 ... mode selection unit

128 ... count completion detection unit

201 ... add gate

202A ... 10000 register

202B ... 5000 register

202C ... 1000 register

202D ... 500 register

data line

203 ... main memory (10000, 5000, 1000, 500, total)

204 ... addition control unit

control line